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EFFECTS OF BINAURAL-BEAT STIMULATION ON RECOVERY FOLLOWING TRAUMATIC BRAIN INJURY: A PILOT STUDY



by Signe Klepp, OT

Signe Klepp is an occupational therapy specialist in Kristiansand, Norway, with ten years of experience in rehabilitating people with traumatic brain injury (TBI). She is also a trained communicologist and runs her own firm, giving specialized health education. Communicology correlates vast amounts of information, knowledge, and concepts with the goal of identifying "master keys," the active ingredients in communication and change. In this paper, Signe examines whether Hemi-Sync® can make a difference in the long-term rehabilitation of people with old TBI. She can be contacted at amps@kleppconsult.no

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Abstract

Patients suffering from traumatic brain injury (TBI) lose the ability to structure their own life. Rehabilitation is expensive in time, money, and effort. A noninvasive, patient-controlled method, binaural-beat auditory stimulation, may elicit changes in states of consciousness and mood. This study assesses the feasibility and efficacy of using this method to improve self-esteem, quality of life, and function of daily living for persons suffering from old TBI.

Introduction

Traumatic brain injury (TBI) results in the need for lifelong rehabilitation because of loss of memory, reduced ability to concentrate, reduced ability to organize and plan, and lack of initiative. The interventions we have today are helping patients to structure their lives and to rehabilitate themselves cognitively. These methods are expensive in time, money, and effort.

This investigator has worked with TBI in post-acute recovery and long-term rehabilitation since 1995, experiencing fully the challenges of cognitive rehabilitation and the expenses related to effort, time, and cost. This work has identified a need for noninvasive adjunctive interventions that are less expensive, controlled by the client, and perceived as helpful by the client.

The Monroe Institute in Faber, Virginia, has developed a technology with binaural auditory beats embedded in music that research suggests may elicit changes in states of consciousness

and mood.^{1, 2, 3, 4, 5, 6} There are no known rigorous scientific projects in the field of traumatic brain injury, but anecdotal evidence exists.^{7, 8}

Using sound for healing dates from man's earliest records. Available today are specially created music tapes and CDs (Hemi-Sync) that have binaural beats embedded to produce an auditory brain-stem response. The binaural beats are generated when two tones of slightly different frequencies are presented simultaneously, one in each ear, preferably through headphones. It is hypothesized that the brain integrates the two signals to produce a third sound referred to as a binaural beat.

Anecdotal Evidence

Case A: In the autumn of 2000, a *Hemi-Sync MIND FOOD® Concentration* CD was given to a young man, age twenty, in the rehabilitation ward of the hospital. He listened to it daily for a period. He suffered from TBI after a traffic accident. After being released from the hospital several months later, he completed his studies (basic computer science) according to schedule, within seven months after hospitalization he got through the exam, and he has now entered new studies. He is the only person the investigator knows who has completed school and continued to study after a serious TBI. The going was rough, but he made it and is still making it.

Case B: A male pensioner, age seventy-six, suffered a fall and eventually moved home to his wife after being hospitalized. He was unable to take any initiative and needed instructions to carry out most tasks of daily living. Even making coffee was a challenge for many months. He was released from the hospital in the summer, and during the winter his wife administered daily listening to *METAMUSIC® Baroque Garden* for a period of three months. During and after this listening period he started to read history books again (he remembered nothing, but he still enjoyed reading). He started solving simple crossword puzzles again, he was able to be on his own for a few hours, and he could go shopping for a few items on his own. This recovery might have happened without Hemi-Sync; we do not know.

Materials and Methods

This is a qualitative study. Because of the small number of participants the results will not be used statistically. Only pre-post measures are compared for each individual respectively.

Instruments

The following instruments were used:

Assessment of Motor and Process Skills (AMPS)

This is a performance evaluation of functioning in activities of daily living (ADL). AMPS⁹ is used to determine how the client's ADL motor and ADL process (organizational/adaptive) capabilities affect the ability to perform functional daily living tasks safely, efficiently, and independently. The AMPS Graphic Report provides an ADL motor and ADL process ability measure, which monitors ability changes in the client. The cutoff value equals the function of a normal, self-sufficient adult. Values under

cutoff on process skills mean decreased efficiency, safety, and/or independence. The computer-generated AMPS Graphic Report is interpreted as follows:

Improvements of at least 0.5 logits [a measurement specific to the AMPS instrument] between Test 1 and Test 2 on either AMPS motor or process skill scale indicate that the client's ADL motor or ADL process ability has changed to a degree that has clinical and statistical meaning (i.e., improved occupational performance).

Improvements of 0.3 or 0.4 logits between Test 1 and Test 2 may not be statistically significant, but may still be clinically meaningful in terms of improved occupational performance.

Short Form 36 Health Survey (SF-36)

This is a health-related quality-of-life measure. SF-36¹⁰ is a generic health-status measure providing information for nine different aspects of health status: Physical Functioning, Role Physical, Bodily Pain, General Health, Vitality, Social Functioning, Role Emotional, Mental Health, and Reported Health Transition. Higher scores indicate a better health state.

Positive and Negative Affect Scale (PANAS)

PANAS¹¹ is a self-evaluation scale and provides reliable and largely independent measures of Positive Affect (PA) and Negative Affect (NA), regardless of the subject population studied or the time frame and response format used. PA—but not NA—is related to social activity, exercise, and satisfaction and to the frequency of pleasant events and is related to diurnal variation. NA—but not PA—is related to self-reported stress, (poor) coping, and frequency of unpleasant events. Low PA and high NA are major distinguishing features of depression and anxiety, respectively. NA is largely unrelated to actual health status. Health complaints are as strongly related to intra-individual fluctuation in PA as in NA.

Recruiting

The subjects had to be over the age of eighteen and diagnosed with TBI. The injury had to be older than two years, and the subjects had all been admitted to the Department for rehabilitation at the hospital. Inclusion criteria were: diagnosed cognitive problems following TBI, and cognitive functioning agreeable with the use of the chosen instruments. The exclusion criteria were: deteriorating cognitive conditions, diagnosed epilepsy or other seizure disorders, psychiatric conditions, substance abuse (drugs and alcohol), or lack of the ability to speak.

Design

The study used a within-subjects, repeated-measures design to assess the effects of binaural beats during the test period. Assessments were carried out before and after listening to Hemi-Sync products for a minimum of five times a week over a period of three months. The assessments were administered in the participants' homes. Participants were given five CDs each, four for improved attention and concentration (*METAMUSIC Remembrance*, *Einstein's Dream*, *Baroque Garden*, and also *Concentration*) and one for relaxation/falling asleep (*METAMUSIC Sleeping through the Rain*). They were free to choose any of

the five selections they were given, and they listened through stereo headphones. They all wrote a daily "listening log" with information about what CDs they listened to, what time of the day they listened, activity during listening, and any other comments.

Ethics

This project was approved by the Regional Office for Ethical Advice, Regional Committee for Medical Research Ethics, Health Region South.

Results

Of the six participants, two showed few or no changes on any of the measures. Also, they had no comments on the experience that indicated noticeable changes in their lives. They are therefore omitted from the case descriptions. They were the two oldest male participants, ages fifty-two and seventy-five. They did listen to their CDs the agreed-on number of times.

The four participants whose cases are described below all listened to their CDs more than the agreed-on times during the study.

Case 1: A young man, age twenty-five, was injured as a child in a traffic accident. He used the CDs mainly to rest/sleep.

Findings: The AMPS showed an increase of 0.2 logits on motor skills from just under cutoff to just above cutoff. The process skills had an increase of 1.3 logits from 0.2 under cutoff to 1.1 above cutoff. This last increase is statistically and clinically significant. The PANAS showed an increase of 7 on the positive scale and a decrease of 7 in the negative scale. This should indicate a more satisfactory social life and less self-reported stress. The SF-36 showed an increase in five measures: Mental Health (+3), Vitality (+5), Pain (+1), General Health (+3), and Social Functioning (+4). Physical Functioning was reduced (-1), probably because he had a back problem the last month of the project. Role Physical, Role Emotional, and Health Transition were unchanged.

In summary of the findings, we see a significant increase on AMPS process skills and some increase on AMPS motor skills. Both measures on the PANAS are positive and SF-36 shows an increase on five of the measures, while four remain unchanged.

Case 2: A young woman, age eighteen, had a bicycle accident three years ago. She used the CDs to fall asleep.

Findings: The AMPS showed small changes; motor skills went down 0.1 logits from 0.4 to 0.5 under cutoff and process skills went up 0.3 logits from just under cutoff to just above cutoff. Neither of these figures is statistically significant. The PANAS scales showed an increase of 22 on PA, indicating an improved social situation. The NA increased 3 points, indicating a small increase in self-reported stress. The SF-36 showed an increase on five of nine measures: Mental Health (+3), Vitality (+2), Pain (+1.6), General Health (+6.4), and Role Physical (+1). The other functions, Social Functioning, Physical Functioning, Role Emotional, and Health Transition, remained unchanged.

In summary of the findings, we see a slight improvement in AMPS process, a big improvement on PA, and an increase in five

measures on the SF-36. Also AMPS motor skills were slightly reduced and NA went up slightly. Four measures on the SF-36 remained unchanged.

Case 3: A woman, age forty-five with a husband and three children, was in a car accident eight years ago. It was several years before she was diagnosed with TBI. She had no particular listening pattern.

Findings: The AMPS did not show any changes. She scored well over cutoff on both tests.

The PANAS scale showed an increase on PA of +7, indicating improved social life and an increase in frequency of pleasant events. NA was reduced with -7 points, indicating less self-reported stress and a decrease of unpleasant events. The SF-36 showed an increase in six of nine areas: Mental Health (+1), Vitality (+10), Pain (+2.1), Physical Functioning (+3), Role Physical (+2), and Health Transition (+39). The other functions, General Health, Social Functioning, and Role Emotional, remained unchanged.

In summary of the findings, we see a positive increase on both measures on PANAS and an increase on six of the SF-36 measures. The AMPS and three of the measures on the SF-36 remained unchanged.

Case 4: A woman, age forty, lived with her husband and daughter. Seven years ago her heart stopped and she suffered a TBI as a result. She had no particular listening pattern.

Findings: The AMPS showed an increase of 0.6 logits on Motor Skills from 1.7 to 1.1 under cutoff. This is statistically and clinically significant. Process Skills showed an increase of 0.2 logits under cutoff. This is not statistically or clinically significant. The PANAS showed a decrease of -11 on PA, indicating reduced satisfaction with social life and a decrease in frequency of pleasant events. Her NA showed a decrease of -6, indicating less self-reported stress and a decrease in frequency of unpleasant events. The SF-36 showed an increase in four of nine measures: Vitality (+1), Pain (+1.9), General Health (+2), and Social Functioning (+3). Mental Health decreased (-1), as did Health Transition (-16). Measures of Physical Functioning, Role Physical Role, and Role Emotional remained unchanged.

In summary of the findings, we see a significant improvement on AMPS motor skills and a slight improvement on AMPS process skills. The patient had reduced NA, and SF-36 improved on four measures. She had negative reduction on PA and reduction on two measures on SF-36, while three measures on the SF-36 remained unchanged.

Discussion

Owing to an increase in traffic accidents, brain injuries are a growing health problem. Recovery and rehabilitation are often lifelong and expensive in time, effort, and money. In this rehabilitation process there is a lack of suitable noninvasive methods that can be administered by the patient him- or herself.

Hemispheric synchronization by binaural-beat auditory stimulation (Hemi-Sync) is designed to alter arousal levels and heighten awareness and performance while creating a relaxed state. Hemi-Sync has been used for about thirty years in connec-

tion with many different diagnostic groups, as well as with healthy persons.

The object of this project was to assess—for the first time—the feasibility and efficacy of using binaural auditory beats in a sample of individuals who have suffered TBI, with the goal of improving self-esteem, quality of life, and function in daily living. According to the data from the instruments used and the feedback from the participants and their families, the results are promising.

After three months of regular listening, four of six patients reported improved social functioning. The two young respondents reported improved sleep and the two older women reported increased vitality and energy. For all four their whole life situation seems to have changed for the better.

Case 1 reported after the project that he now sleeps better, he is less restless, feels calmer, has an improved social life, and manages a steady 50 percent employment. Improved sleep may be a key factor in the overall improvement in his life.

Case 2 was preparing for an exam during the project, as well as planning her further school career and planning to move away from home. She completed her exam successfully and is now pursuing her career. She is now living on her own. Improved sleep may be an important factor in her improved functioning.

Case 3 has a husband who did not want to give the CDs back to the investigator. He thought his wife had more energy, had more of a temper, and reacted more strongly and quickly during the project. The woman herself says that she did not notice these changes. What she did notice was an increase in energy and feeling more alert and present.

Case 4 experienced stress during the project, as she was worried about her work rehabilitation. Work rehabilitation agreements were made shortly before the project finished, and after that she showed unexpected improvements both in her ADL and her work performance. In spring 2002 she was estimated to need two hours additional municipal homeservice per week. After the project (autumn 2002) her need for additional help was reduced to thirty minutes. In the work rehabilitation she is now evaluated to be able to qualify for paid work within a couple of years. During her previous years of rehabilitation, paid work was never mentioned as a realistic goal.

More studies with binaural auditory beats should be done in patients with old TBI and perhaps also in the post-acute recovery after TBI. Prospective controlled trials are necessary to predict efficacy.

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PROFESSIONAL SEMINAR REGISTRATION

The Twentieth Professional Seminar, "**Hemi-Sync: The Bridge between Magic & Reason**," was announced in the last issue of the HEMI-SYNC JOURNAL. The event is scheduled for March 25-29, 2006, and the keynote speaker is Joseph M. Felser, PhD. Dr. Felser's book, *The Way Back to Paradise*, was reviewed in the winter/spring 2005 TMI Focus. Registration is under way and several presentations have been confirmed. We look forward to receiving your registration and hearing from professional members who have something to share about their work with Hemi-Sync. The *REMOTE VIEWING PRACTICUM* is scheduled before the seminar and *HEARTLINE* and *TIMELINE* are scheduled afterward. Participants who would like to come early or stay late and attend a program should contact registrar Karen Viar at TMIprograms@aol.com



GROUP THERAPY FOR SEVERELY TRAUMATIZED REFUGEES WITH A FOCUS ON SLEEP DISORDERS



by Ursula Fürstenwald

Ursula Fürstenwald, a psychologist and psychotherapist with OASIS—an organization using an interdisciplinary approach with counseling and treatment of severely traumatized refugees suffering from post-traumatic stress disorder (PTSD)—contacted TMI with a proposal for a pilot study using Hemi-Sync®. Serious sleep disturbances are one of the main secondary symptoms of PTSD, especially for survivors of torture. Hemi-Sync was employed as an adjunct to focused group therapy in an attempt to relieve insomnia. The study was conducted in Copenhagen, Denmark. This paper is based on a presentation made by Ursula and psychomotor body therapist Gita Nielsen at the ECOT Conference held in Berlin, Germany, in May 2003.

Introduction

For many years, OASIS has wanted to initiate a project dealing with sleep disorders. In 2000, we obtained economic support for such a project from the United Nations' fund for torture victims and carried out the first phase in 2001. Most traumatized people suffer from sleep problems. Lack of sleep in itself can cause irritability and concentration and memory problems and thereby intensify a client's other post-traumatic stress disorder (PTSD) symptoms. The project's objectives were to reduce the high level of nervous system activity and to improve sleep quality. Group therapy was used, with the aid of an interpreter. Two groups completed the course of treatment.

The first group consisted of five Arab men who were already under treatment at OASIS. They met eight times for two hours once a week. The second group consisted of five women—four Arab and one Bosnian. They met ten times for two and a half hours once a week. In addition to group therapy, each individual was interviewed to ascertain his or her sleep pattern. After completion of the group process, we met with each participant again to compare and evaluate sleep patterns before and after treatment.

Sleep theory

It is very important for a traumatized person to know that the number of hours of sleep required during a twenty-four-

hour period to feel rested and to function optimally varies from person to person. Our sleep patterns also change throughout our lives.

Sleep patterns

All of the male participants and a couple of the women took sleeping medicine. Dosage was not changed during the project. Every man had suffered sleep problems for at least ten years. The duration of the women's sleep problems varied from since childhood to two years.

Childless women's twenty-four-hour rhythm resembled the men's, who stayed up, smoked, and followed the news on the Arabic channels, going to bed between 3:00 and 4:00 A.M. They slept a couple of hours interrupted by nightmares and had difficulty falling asleep again. Often, they did not sleep until first light. Women with children got up in the morning and typically took a nap later in the day. Although they went to bed before midnight, they often lay awake one to two hours, then slept a few hours interrupted by nightmares and periods of wakefulness.

Method and planning

In addition to being interviewed using a questionnaire designed for the purpose, the participants filled out a sleep diary every morning to record what had happened during the night, including taking any stimulants and medicine that could affect their sleep. The diary was delivered to the group leaders each week. Group sessions consisted of client feedback, body therapy instruction, and theoretical psycho-education on sleep hygiene and the physical and psychological consequences of trauma. The women's group also used "conflict-free imagery" and a Hemi-Sync® binaural-beat CD.

Body therapy exercises

The body therapy program was based on Dr. Edmund Jacobsen's neuromuscular training. Physiological studies have shown that a muscle that has been completely tensed and is then relaxed has a lower degree of tension than before. This affects nervous system activity, which then regulates the stress level and the condition of wakefulness. Each participant carried out the same exercises in the group and at home while listening to a special CD. Instructions were in Danish and Arabic for the men and in Serbo-Croatian for the women. The men also went through a training program for headache relief twice. The women's group received training to relieve tension in the lower back, shoulders, and neck. Several participants fell asleep during body therapy instruction. They said later that they would otherwise never do that with people outside their family.

Theory

Participants were made more conscious of external factors that negatively influence sleep: ingesting coffee, tea, alcohol, or tobacco before going to bed and watching nightly news programs. Sleep hygiene, sleep-aware rhythm, and the connection between bed and sleep and its influence on sleep quality were addressed. In addition, we discussed trauma's consequences and

significance in a person's life.

Results

Three out of five participants in both groups fell asleep more quickly after the group process than before. Using a scale from one to ten, individual participants' evaluations of the importance of sleeping problems in their lives indicated improvement. This created hope that something could be "moved."

The three participants in each group with the strongest personalities profited most from the group process. Personality traits were greater determinants of how traumatic effects were managed than the number of traumas or the degree of violence.

The two participants in each group with less intact personality structures were often out of contact, late for appointments, and absent without notification. Some of the women broke the new rhythm they had learned because of pain and acute illness. We emphasized the importance of starting again as soon as the pain lessened.

The men's interpreter was positively surprised that Arab men could talk together so well and be in the same room dealing with something as personal as sleep problems. He surmised that the participants had developed a feeling of trust and felt they could count on one another.

Body therapy

In both groups, participants who used the instructional CD to practice the exercises regularly at home experienced a greater degree of calm and relaxation in their daily lives, and most of them experienced better sleep quality. Some described reduced pain. The women's feedback indicated a general development of body consciousness. Some men found it easier to do the exercises together. Perhaps because of exposure to imprisonment and torture, they felt more secure in the group. The women were usually better about practicing the exercises every day.

Theory

The psycho-educational sessions were important in relation to convictions the men and women had beforehand. Communicating that there could be differences and that changes could occur during the process relaxed some of their stiff attitudes and beliefs. Trauma theory had the strongest resonance with the men, possibly due to their greater exposure to imprisonment and torture.

Binaural-beat CD

This intervention and "conflict-free imagery" were used only with the women's group. *METAMUSIC® Sleeping through the Rain*, a Hemi-Sync® CD developed by The Monroe Institute®, was used to calm the thought processes and reduce the high activity level of the brain to facilitate falling asleep. The CD employs binaural-beat frequencies conducive to deep relaxation blended with relaxing music. One very anxious woman was unable to listen to the CD. Another woman skipped the beginning of the CD, because she perceived that part as a bit threatening. After the sleep project concluded,

however, she began listening to the whole CD. For the women who listened to the CD, the time necessary to fall asleep became shorter and the time it took to fall asleep after waking up during the night was also shorter. Some had better dreams. We think the effect of binaural-beat sound is intriguing and worth further investigation.

"Conflict-free imagery"

The participants were asked to find or create a conflict-free or peaceful image that resonated through all of their senses. The "peaceful" image was not used systematically. Originally, it was to be used during the day when the participant felt preoccupied or afraid, as well as before falling asleep and after *Sleeping through the Rain* as a pleasant way to fall asleep. The three participants who used conflict-free imagery achieved the desired effect of relaxation. It would be interesting to combine the Hemi-Sync music CD with the conflict-free imagery and to study whether there is a greater calming effect on the nervous system.

Conclusions

To draw generally applicable conclusions would demand more groups with more participants. Through the process with these two groups, however, we found that most participants became more conscious of the effects of external events, stimulants, and worries on their sleep, as well as how a calm environment for sleep and doing relaxing exercises can affect sleep quality. They learned that improving sleep depends on personal effort. Because those with a well-integrated personality structure appeared to benefit more from our approach, it would be worthwhile to explore resiliency factors.

Fasting for Ramadan and the world political situation—the attack in New York on September 11 followed by the war in Afghanistan—greatly influenced our clients. Their resultant anxiety and insecurities made it harder for them to focus on sleep improvement.

These preliminary results were so promising, however, that we plan to continue the project with a few changes: trying additional methods and improving those we have already used. Possibilities for cooperation have been discussed with a newly established sleep laboratory in Copenhagen.



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